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THE JOURNAL OF PHILOSOPHY

A BEHAVIORIST ACCOUNT OF INTELLIGENCE

I

IN isolating and describing intelligence, we have to take account of four sets of factors: stimulus-patterns, reaction-structures, reaction-patterns, and the word "intelligence" itself as a specifically patterned reaction employed as a means of designating and describing the thing or function meant.

First, is the fact that stimuli are patterned—spatially, temporally, and spatio-temporally. This is the fundamental objective fact that makes differentially adaptive behavior possible.

By saying that our stimulus-patterns are spatial, I refer to the fact that any given object, from any given point of observation, exhibits a spatial outline, form, or pattern. This is true of objects as wholes; it is true of different subordinate features presented to view. A house presents a general, gross pattern; its sides, roof, windows, doors, the subordinate features of the parts, present each its own spatial pattern in any given perspective. By temporal pattern, I refer to the fact that the stimuli of our several sense organs or receptors differ in their frequency or periodicity. By spatio-temporal pattern, I refer to the fact that objects and their several spatial patterns persist with more or less regularity, continuing to afford the temporal patterns of stimuli characteristic of their own nature and whatever medium happens to intervene between us and them. Also, moving objects, and objects that appear to be moving, because of our own changing of position, exhibit a space-time figure or pattern.

It is important to note that we do not have to learn a different pattern of adaptive behavior for every different object. Objects fall into classes; and, within certain limits, behavior suitable to one object of a class is suitable for others also of that class. So it is that we have been able to devise class designations, distinctive combining responses, which serve as valid substitutes, in thought and social communication, for their respective designates, both in groups and as individuals. We may note also the principle by which objects and subordinate features of them—in other words, stimulus-patterns—fall into classes. This would seem to be some principle of statistical homology. By "statistical homology" I mean that measurement and ranking of stimulus-patterns of any given kind will show that they conform to a normal curve. It is apparently by virtue of this fact

of natural conformity to a normal curve that objects as wholes, and subordinate features of them as well, fall into groups or classes designable by class names. This is apparently the fact that makes an habitual adaptation to one of a class of facts available for others of that class. It apparently indicates also the range within which such adaptation is safe or valid.

Second, is the apparent fact of statistical homology in every item of the receptive, connective, and reactive apparatus involved in every reaction-structure homologous among any given class of animals. This postulate of statistical homology applies to the several homologous structures of any given kind of animal; it applies also to the numbers, magnitudes, and forms of the several anatomical elements, or cells, of which homologous structures are comprised. It applies to their capacity for what I may call "reach," or magnitude of reaction; for vigor or intensity of reaction; and for mutual organization among themselves. It applies to capacity for tonus among the several sets of muscular effectors, which is capacity for "attitude," "set," "urge," "readiness," or motivation. It applies to relative intensity, frequency, and excellence of motivation, both required and actually received, for any given pattern of behavior, in response to any given stimulus-pattern.

This fact of statistical homology, in kind, amount, and excellence of motivation, is an overlooked factor behind all the intelligence scores that we get by use of standard tests. In other words, it is unfair to the subject to lay upon his heredity all the blame or credit for intelligence scores, by innocently presuming that he and all the other subjects have been equally well motivated and practised for every kind of situation, and for every kind of behavior tested in relation thereto. This being the case, it would be a wicked and inhuman thing for the teaching profession to treat its pupils and students as so many exhibitors of so many different I.Q.'s. We are bound to afford the best situations possible, in the matter of motivation as well as in that of objective materials to work with, upon which the current product of heredity, of already previous motivation, and of previous practice, may work. Even college and university have a responsibility here. They must be sensitive to the problem of technique of motivation in order to supplement and supplant the more or less inadequate motivation to which their students have been previously accustomed. They can not afford innocently to evade or ignore the problem of motivation for study and for living, not, at least, until they have turned out a generation of teachers and parents with appropriate techniques for such work.

Third, is the fact that every reaction executes a space-time pattern—a pattern that generates a certain spatial figure and that re-

quires a certain interval of time for its execution. To this we may add that the structures themselves that describe this pattern have a patterned distribution or arrangement, differing and changing, of course, with the posture of the agent, and with the course of the reaction. Acts as well as objects are patterned. Differences of pattern are the fundamental intelligible fact of behavior as well as of the objects to which adaptation is effected.

Fourth, is the pattern of the word "intelligence" itself, and the history of its origin as a designative term for a specific aspect of behavior. Save perhaps in cases of onomatopoetic words, simple root words are not likely to have ticketed upon them any evidence of the process of their creation, or of the particular aspect of the object or act that they were intended to designate. But it is different with the compounding of native words, and with the borrowing and compounding of alien words. The moment of thus compounding or appropriating a word as a means of designating a newly isolated fact of experience is often a highly revelatory and significant fact in the history of thought about that kind of fact. So it is with our word "intelligence" and the kind of fact that it was coined to designate. While *any* vocal gesture not otherwise pre-empted *might have been employed* for this purpose, yet the fact that the word is a compound of already current and meaningful words helps us to discern what was the nature of the fact that the creator of the word had isolated and was seeking to designate. Knowledge of that significant moment, as its nature is revealed by the form of the word itself, helps us to discern whatever of historical continuity there is in the use of the word, and perhaps to check up on our own more or less vacillating and unspecific uses of it.

II

With such reflections "in mind," we might proceed by translating the word "intelligence" by our native word, understanding, and by then trying to define "understanding." But this word is genetically more highly figurative than "intelligence." It does not reveal what it is that is supposed to do the "standing," nor what it is that this thing stands "under." But it appears not to have originated as under*standing*, as we enunciate it, but as *under*standing. In the first instance, the verbal element, *stand*, was transitive, not neuter. Accordingly, to *under*stand was originally to stand something under one's feet; the thing *under*stood was something stood beneath his feet. Thence the act of *under*standing was that of getting something under one's feet, as a basis for further advance; and thence the "mental" act of *under*standing was that of getting a foundation under one's "mental" feet. This interpretation is

highly suggestive of the function of understanding, but not of its real nature. But our definition by this procedure would conclude with a figure of speech rather than with an accurate scientific description of what actually goes on in exhibitions of intelligence. The implication of use of a figure of speech is that the user and his hearer or reader already understand at least the thing used figuratively by way of allusion and illustration. In the use of such figures in our psychological and philosophical tradition, the exact reverse is commonly true. In original ignorance of the thing actually referred to, we have used animistic figures of speech in the effort to illumine, and then further figures to shed light upon the attempted illumination; all of which has only served the further to darken counsel. Only as we have turned aside from this verbalistic tradition, or gone behind the figures, to see what it was that actually prompted them, have we made real progress in understanding. And then the figures have generally so ceased from having any significant meaning that we have dropped them altogether. Our science of psychology and the processes of education, supposedly guided by its findings, can no longer afford to rest upon figures of speech. Or, perhaps, rather, as Pepper suggests, it must continually create new figures, more highly relevant to the better discerned pattern of the facts which it is trying to make intelligible, in the interest of improved use and adaptation.[1]

Neither can it afford to rest upon dictionary definitions—until scientific definitions have got into the dictionary. We must differentiate between two kinds of definition. First, the traditional dictionary or verbal definition, in which one set of words is substituted for another of more or less equivalent "meaning." Second, a type of definition which defines or delimits the range of facts to which the defining word or phrase serves as a definitely patterned response, a more or less descriptive designation, and one which may be used substitutionally, in thought and social communication, for that range of facts.

This means that the term "meaning" itself requires such definition. The "meaning" of an object is the complex of acts which that object itself has come to evoke from an agent as modes of successful adaptation. It is not a chain of words, save as these are *experienced substitutes* for the several acts of that complex. A traditionally correct verbal reaction may be an adequately adaptive reaction for the purpose of social converse. But the person able to make such correctly abstract reactions and adaptations is not necessarily capable of adaptation to the things designated by his correctly verbal reac-

[1] Stephen C. Pepper "Philosophy and Metaphor," this JOURNAL, Vol. XXV, pp. 130–132 (1928).

tions. An object that we have learned to perceive suggests, points to, means—and hence prompts to—the set of reactions by which we have learned to adapt ourselves to it. Adequate meanings of words *are* these sets of reactions that their objective designates mean. "Mean," our English verb, is derived from the Anglo-Saxon *maenan*, "to point to." As a perceived object means, points to, or prompts to the set of adaptive acts which we have learned to perform in relation to it, so does the perceived name or verbal designation of the object "mean" this same set of adaptive reactions. As a mere meaning, a moment in the act of perceiving, this set of adaptive acts, or any one of them, is performed only implicitly. A stimulus-pattern, as perceived, *means* one or more of such adaptive acts, which may or may not be overtly performed; and such an adaptive act itself *means*, in the same way, the act of adaptation to the consequences of this act—which also are experienced as meanings, and not as objectively present realities.[2]

The word "intelligence" comes from the compound Latin verb *intellegere: inter* (between, among) plus *legere* (to pick, to choose, and, in the literary period, to read). *Intellegere*, to behave intelligently—or understandingly—is to pick or choose between or among situations or stimuli, by picking or choosing between or among their meanings. We might then define "intelligence" off-hand as a word used to designate the fact of recognizing differences and acting accordingly. Objectively, such differential behavior is possible because the stimuli among which an animal picks or chooses are differently patterned, each kind of pattern exhibiting a statistical homology as to form, magnitude, and intensity. This fact of differential stimulus-patterns is just as true of adaptive acts, even though performed implicitly, as meanings, as it is of external objects. Subjectively, such differential behavior is possible because the animal has a brain—an organ of differential connection, or differential gear-shift, intervening between receptors and effectors located respectively in different parts of its body.

III

Etymologically and psychologically, then, to behave intelligently is, primarily, to pick or choose among differently patterned stimuli; secondarily, it is to pick or choose among differently patterned meanings. In both cases it is to react differentially to differently patterned stimuli, but not to react indiscriminately differentially. It is to react consistently differentially. That is, to behave intelligently implies memory, in the continuous sense of "remembrance"—a per-

[2] My introduction to the nature and importance of "meanings" I owe to John Dewey's writings; e.g., *How We Think* (Boston, 1910), *Essays in Experimental Logic* (Chicago, 1916), and *Experience and Nature* (Chicago, 1926).

sistence of structure-organizations effected by previous successes and failures; failures that were not fatal and that hence, through the organization-effects that they have left, have a value for directing further behavior.

In large part these structure-organizations may be thought of as being synaptic in character. They are Thorndike's "bonds." But these bonds are not to be regarded as Stimulus-Response—S-R—bonds, but rather as Receptor-Effector—R-E—bonds.[3] In case we try to think of them as "S-R bonds," seeing that the stimulus and the end-response occur at different instants, we may have some difficulty in fitting the term "bond" to the conception of a temporal sequence. Of course, there is the nervous current intervening between the occurrence of the stimulus and the muscular or glandular release that constitutes the response. But it is not a spatially continuous connection, any more than is an electric wave, passing over a telegraph wire; and this latter is certainly not thought of as a "bond" between sender and receiver, as is the physical conductor. But as between receptor and effector there is a real physical continuity, in so far as electronic theory permits us to think of such a continuity. The term "bond" fits this latter aspect of the case; it does not fit the other. The memory—remembrance—involved in intelligence, as elsewhere, consists conspicuously in the persistence of the intercellular organizations that differentially take place according to the patterns of stimuli and responses. To put the matter in another way, then, to behave intelligently is to behave adaptively, in the light of previous experience. Through this fact of memory, intelligence exhibits a "temporal dimension" in relation to the past. This, to be sure, is a figurative illustration, but it seems to pass the test for illumination.

IV

Through the fact that consistently differential behavior involves a more or less permanent persistence of structure-organizations, and through the fact that more precise adaptation is always possible, intelligent behavior manifests growth in precision and in range of details. These structure-organizations, or possessive memories, accumulate at a higher or lower rate according as they are more or less readily and rapidly effected, upon the hereditary basis and with better or poorer motivation and practice relative to it. Their possible rate of accumulation may be in some way correlative with this raw hereditary capital, but we should never forget for a moment that

[3] E.g., *The Original Nature of Man* (New York, 1923), pp. 6–9, and elsewhere; and his *Psychology of Learning* (New York, 1921), p. 1 and *passim*. He often uses the word "connection" instead of "bond"; the criticism applies here also.

at any given time the accumulation has been affected by motivation. An animal—even an oyster—can seek the stimuli to which it will respond. This seeking probably consists in a present condition of tonus in the muscular structures—primarily and most particularly the autonomic—that will make the consummatory response to the stimulus, when this is come upon.

The animal's act of seeking still further sensitizes it—makes it more highly receptive—to the kinds of stimuli necessary to the consummatory reaction, and to refinements in their details. We usually find what we are looking for, if we look long enough, and we are more likely to find if we are seeking. If a child's educational motivation, by conditioning him to negative, prohibitive stimuli, has actually insensitized him to certain kinds and ranges of stimulus-pattern, the fact that he is not intelligent in relation to them is not to be imputed to inheritance or raw native capacity. Growth in intelligence is dependent upon motivation as well as upon growth of raw capacity, if such a thing can be imaginatively or theoretically isolated, as it can not physically and perceptually. This native growth itself is conditioned by the kind of motivation that the child has had. The motivating factor of educational situations is the fundamental one, even after the subject has learned to motivate himself, well or poorly, according to the relative excellence of motivating experience that he has had. Just as hunger, or feeding-motivation, normally precedes eating, so does normal and healthful education proceed upon a basis of prior motivation. Technique of motivation is the greatest need of current education, to give native intellectual capacity the chance for development that it deserves, and to provide the best possible motives for its use.

V

But to behave adaptively in any other sense than immediately to the spatially spread situation implies a readiness for more or less immediately future contingencies, and even a previson of them. That is, it implies an ability to experience meanings, and meanings of meanings. A successful intelligence thus exhibits its temporal dimension also in relation to the future—the greater, the higher the intelligence. Or perhaps we had better rate separately the spatial and temporal "dimensions" of intelligence. Some persons with a high aptitude for immediate social adaptation seem to rate low in ability to take account of consequences—meanings, and meanings of meanings; and perhaps the converse is true. At any rate, to behave intelligently and hence adaptively implies such a caring for consequences as to make adaptation worth while. Human intelligence, chiefly through the fact of language, exhibits this temporal dimension in a much higher degree than does that of any lower animal.

Through this fact of language, man has a set of respectively patterned substitutes for original situations or stimulus-patterns, to which he can react as to those originals themselves. In this way he can immediately exhibit, either explicitly or implicitly, the reactions found appropriate to those original situations, even in their spatial and temporal absence. Thus also, with these reactions as stimuli, he can react to them in turn and thus discern the consequences of these further reactions, and can pick and choose among them the ones most desirable to be made explicitly at the proper time. Any experience that he has had he can rehearse or dramatize with variations in that inner medium of implicit behavior which constitutes thought. This inner dramatizing and trying out he can either revoke and not exhibit in overt behavior, or he can enact it overtly and enjoy or suffer the consequences. In this way he can enter into the experiences of all sorts and conditions of men. He can thus widen the range of his human understanding and sympathies; and thus he can further humanize himself, living his life on a world-wide and world-deep stage of space and time. He can anticipate and forestall the occurrence of undesirable consequences, by removing or modifying their conditions. He can maintain or contrive the situations that will evoke the desirable. But whether his stimuli be external to him or whether they be his own reactions, their distinguishing characteristic is that of pattern, and his intelligence consists in the fact of his picking and choosing and reacting differentially among them.

Human intelligence, then, is manifested in man's reacting adaptively in relation to situations both present and absent, in point of both space and time. Human intelligence can anticipatively take account of consequences, and of the consequences of consequences. It can take care that there will be humanly valuable consequences to be taken account of, and the desirable kind of human beings as consequences to take account of them. It can do all this, the most natural thing in the world for it to do; but thus far in its history it has been too much engrossed with problems of immediate adaptation to discover its own true function.

VI

Thus it is important to note that this process of adaptation makes a demand for future consistency as well as for consistency with the past. Consistency with the past consists in the mechanical fact of memory. But intelligent consistency of adaptation has reference to the future, a consistency with the demands of life, a consistency with regard to life-spelling consequences. It may be the utmost folly to try to keep one's present and future consistent with his past, and so it is with social effort to maintain a tradition or an institution. The

primarily intelligent question to ask regarding any practice, tradition, or institution is, How does its maintenance in its present form seem to help in spelling a continuance of the life process of the species?

The actual authorities or sanctions for the life of the race are not to be found in the thoughts and records of the past. They are to be found in the pressure of the individuated or discriminated problems whose solution spells assurance of a continued life of the group, but fundamentally of the race. Real authority is an accepted responsibility for consequences. It is by this that we are authorized to go ahead with the job. Only as personal and institutional authorships of the past serve as instrumentalities for assuring our own desired consequences do we accept them at all as authorities. We differ in our acceptance of historical pronouncements as authorities, because our problems and accepted responsibilities are different, requiring correspondingly different instrumentalities for their solutions and fulfilments. But there is one problem in which it would be natural for all men to agree, could they but free themselves from the bonds of immediacy, and that is the problem of achieving assurance for a continuance of the racial life. Only by keeping our eye upon this supreme human problem can we discern true from false problems—and true from false "authorities"—and secure for all individuals what is rightfully theirs as members of the race. Intelligent responsibility is responsibility for human life-consequences, not for a perpetuation of specific instrumentalities. The kind of job to be done determines the form of tool for the work. Function determines form. "There is a discipline for ideas as well as for persons," says Professor C. H. Cooley, "and every thought is harmful that is not kept in order by a larger thought."[4] Is not this thought of the racial life, and of the effect of consequences upon the racial life, that "larger thought" necessary for the discipline not only of lesser ideas but of persons—and of social and political groups—as well? The race has not been wrong in setting a supreme value upon intelligence, but it has seldom seen wherein its value lay. Indeed the current holdover of "fundamentalism" is evidence of a lingering lack of faith both in intelligence and in man.

We are now in a position to give a more precise definition of intelligence, and of several other processes intimately related to it.

"Intelligence" is a term used to designate the fact of behaving adaptively. We must beware of trying to define it in terms of the unknowns, "ability" and "capacity," which can only be inferred from the observed facts of differential adaptation. And we must further be on our guard against employing these inferred unknowns

[4] *Life and the Student,* (New York, 1927), p. 218.

as a predestined fixity, that can not be affected by changed motivation. If adaptive behavior itself can be changed and improved, then so can capacity, in any sense in which we may justifiably employ this term. We have a right to infer that one's reach may possibly exceed his present grasp, but not that it is less, and it is impossible precisely to predict the effect of improved motivation. The fatalistic, Calvinistic manipulation of the concept of "capacity," by our intelligence-testing statisticians, is apparently an "innocent" but mischievous hold-over in "science" from its theological grandmother.

VII

Perception is an exhibition of intelligence. Here again etymology is suggestive. The word "perception" is derived from the Latin *per* (through, thoroughly) plus *capere* (to catch, to grasp, to take). The old Roman who first isolated the process sufficiently to feel a demand for a designating word apparently intended by this word to indicate that a stimulus-pattern was thoroughly isolated, caught, taken in—of course as a condition of adequately differential reaction and adaptation. But perception, for the human being, involves more than the isolation, individation, or "cutting out" of stimulus-patterns. Normally, perception is a three-step process.

First, is an already active background of tension or tonus, out of which the definitely perceptual act emerges. This temporal background consists in an attitude, disposition, set, urge, drive, demand, wish, or tension—tonus—for a given kind of consummatory end reaction, and hence for some kind of stimulus-pattern that has become conditional to this reaction. This is the initial end of a consummatory act already in process, but whose terminal end is dependent upon a particular sort of a stimulus, and hence upon a projicient activity necessary to secure this stimulus. This initial end of the consummatory act is the work of one or another segment of the autonomic apparatus, the same segment that will be primarily concerned in the terminal end of the act. It serves as a demand upon the projicient apparatus for bringing the animal upon the stimulus that will release the implicit action of this segment into explicitness as the terminal end of the act. In this initial end of a consummatory act, at once the initial step of a normal act of perception, the pattern of the terminal end of the consummatory act is already laid down, in a patterned tonus of the autonomic apparatus. In this anticipatory set of the organism, constituting the initial end of the act, we are to discern the actuality of the Freudian wish; also the way in which the *Gestalt* theory finds the response participating in its own production.

If we include with this initial action of the autonomic segment

the response of the projicient apparatus in helping this segment to "seek" the stimulus necessary to release its tension, in the terminal end of the act, then the second step of a normal perceptual act consists in isolating or individuating that necessary stimulus-pattern from among the many others in which it is involved. Among those lower animals that have not developed any sort of language substitutes for objects and actions, nor ability for implicit performance as substitutional meanings for explicit acts, this second step constitutes the really perceptual act. For such animals it consists in an individuating of the stimulus-pattern upon which the terminal end of some consummatory act, then implicitly in process, will follow.

But for the human being, most stimulus-patterns have more than one meaning, especially in their larger settings. Hence the third step in perception, an occurrence of meanings, among which selection may be effected for the business in hand. The act of picking and selecting among meanings is temporally beyond the perceptual act proper. It belongs to the sphere of thought, for which perception furnishes the data: first, distinct stimulus-patterns, and secondly, meanings, which, as responses, are subjective stimulus-patterns. For the human being, it is not enough to isolate the objective stimulus-pattern. He demands to know what this pattern means, in terms of behavior. The earliest intellectual question of the infant is "What's that?" Here he is inquiring for the appropriate verbal response for purposes of social converse. But soon he finds that this is not sufficient. He must adapt himself to other things than his fellows. His next intellectual question is, "What's that for?" Here he is beginning to ask for social help in the getting of meanings for his own personal operations and adaptations. Hereafter an act of perception is not complete for him until one or more meanings, operational rather than verbal, "arise," in response to his individuating of stimulus-patterns. This "arising" of meanings—implicit performance of already learned operative, adaptive, projicient reactions—constitutes the third and concluding step of a normal act of human perception.

Perception, then, is the intellectual process or act by which stimulus-patterns are individuated and their meanings evoked. A percept is a particular instance of this kind of behavior, and is preliminary to selection among the meanings thus evoked or experienced. Perception, perceiving, is the intellectual or differentiating behavior upon the basis of which preliminary or provisional, rational adaptation to our objective situations is effected. This rational or mental phase of adaptation is a process of implicit dramatization and selection among the meanings of perceived stimulus-patterns.

VIII

An idea is a meaning. It is an implicit action of a reaction-structure by which an operation or adaptation is effected.[5] And its occurrence may serve as a stimulus to generate or release other idea-reactions, as inferences. Where is an idea when it is not occurring or being experienced? It simply is not. An idea as a persistent thing or possession can be nothing other than the structure-organization through which the idea as event is effected. This means that we should not think of ideas as having existential, but only eventual or occurrential status. We do not "have" ideas, we execute or perform them. On the other hand, the structures through which they are effected are existential in status. They are persistent, space-time realities, conforming to the laws of use and disuse.

We should distinguish between ideas and images. An image, in the absence of the stimulus-pattern seen, heard, etc., is the act of focusing or adjusting a receptor apparatus, in response to some substitute stimulus, for perceiving just that stimulus-pattern. Such an act sensitizes or makes more highly receptive the apparatus thus adjusted, for the kind of stimulus-pattern for which it is substitutionally adjusted. It apparently also gives the adaptive projicient apparatus a heightened tonus for receiving currents set up in the receptor. It is quite possible that this sensitizing of an organism for its stimuli is a matter of adaptation in the muscular effectors, both of the receptor apparatus and of the projicient, and not any sort of change in the actually sensory or receptive substances. But that is another story. An image, being a reaction, can serve as stimulus to evoke another reaction, just as can an idea; and thus it can participate efficaciously in a process of adaptation. It is important to note also that adaptation, as applying to the projicient apparatus, is a matter of procuring stimuli for the autonomic apparatus. But this also is another story.

Ideas—and images—are differentiated from each other in the same way as external objects, by virtue of differences of pattern among the reactions that they are. It would be wholly proper to say that we perceive images—and ideas, which are implicit reactions. The patterns that they exhibit, in so far as these are patterned conditions of further differential behavior, are not those of synaptic distribution in the brain and nervous system. Rather, they are patterns of distribution of muscle cells involved in the ideational and imaginal reaction. In a considerable measure, verbal reactions substitute for more pervasive ones; as such, they are a great economy of time and effort. Yet along with them, let the slightest inhibition,

[5] This conception of ideas as being "operational" I owe to P. W. Bridgman's *The Logic of Modern Physics* (New York, 1927), Chapter I.

doubt, or inadequacy arise, go these more pervasive dramatizing reactions, implicitly performed, that are the meanings of the verbal reactions being made. In really familiar and habitual thought, the implicit verbal reactions alone may constitute the idea; yet always there is in abeyance an accompanying stream of these implicit dramatizings of the behavior meant by the words. We do not think with the brain alone, but with the whole body, and only the proximity of the speech mechanisms and the ocular adjustors—in particular—to the brain has permitted the mythical transfer of the old soul-idea of thought to the brain. The notion of "central processes" and of "centrally aroused" nervous currents appears to be a piece of twentieth-century myth masquerading as science.

So far as we can discern, there are no receptors within the brain, including the cortex, save as one neuron is recipient to an agitation transmitted by one adjacent. Otherwise than this there are no receptors inside the brain, nor access of stimuli to act upon them—save changed blood-pressure, which may serve as a rather pervasive stimulus and hence evoke a rather unspecific response as to its location and extent. Nor are there any effectors within the brain, save the pineal gland and the pituitary body, whose effects are distributed by the blood-stream. Again, no nervous current that we can ever know about ever dies down or peters out within the brain; for to know about it, or about its stimulus, would be to make a response to it, through some effector outside the brain. For us human beings, this effector is characteristically the speech apparatus. But any stimulus or nervous current sufficient to set off the speech apparatus is adequate to evoke some other form of response, as our repertory of gesture and the sign language of the deaf testify. The fact is that we must reconcile ourselves to considering the brain as but an inconceivably complex apparatus of differential connection or gear-shift between receptors and effectors variously distributed throughout the body. When some one begins to specify verifiably any other function for the brain, then it will be time to begin to regard it scientifically in some other light than this.

All this will sound strange to those who are accustomed to thinking of percepts and ideas, through which intelligence carries on, as being constituted, respectively, of more and of less vivid clusters of "sensations." Here we have a need of a redefinition of sensation. By any definition of the term "sensation" that I have ever seen, a sensation was an entity that could in no way serve as a stimulus to any receptor or other organic substance. Hence it could in no way serve as an occasion for a change in behavior. It could in no way be even designated, to say nothing of being described, seeing that either a description or a designation is a response to a situation. The

first obvious conclusion to draw here, is that those who have been trying to carry through the sensationalistic or "qualitative" theory of consciousness and thought have been responding to efficacious stimuli, in their talk about sensation and consciousness, but stimuli that they were overlooking, because of the spiritualistic slant that tradition had given them. A second conclusion is that if we can think or talk at all about "sensation" or "conscious quality," it is possible to bring out into the open the facts actually talked about and to describe them in objective terms. I believe that this can be done and that I can point the way to so doing, but such attempt must be reserved to some future occasion.

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BOOK REVIEWS

The Evolution of Scientific Thought from Newton to Einstein. A D'ABRO. New York: Boni and Liveright. 1927. Pp. xx + 544.

It has been the discovery of many who have courageously undertaken the task of self-education in the theory of relativity that the extant popular and semi-popular books upon the subject are notoriously bad. Most of these enthusiasts have found to their dismay that practically all of the knowledge acquired through the elementary books had to be promptly unlearned before the more advanced, technical treatises could be comprehended. The so-called introductions to the theory proved to have been either definitely false, or else so misleading as to be valueless. Thus there has been a long felt need for an elementary text upon the theory of relativity which will combine the clarity and lucidity of a popular presentation with the authority and precision of a scientific treatise.

Mr. D'Abro's contribution to the philosophy of science satisfies this need admirably. Here at last we have a book on relativity which is thoroughly good—a comprehensive survey of the special and general theories, accurate to a surprising degree, yet couched in non-technical language, and involving a very minimum of mathematics. The whole book is characterized by an ease of presentation and an unassailable style. The frequent repetitions for which the author finds it necessary to apologize never seem to burden the text; each repetition, in fact, and each new example seems to makes its distinct contribution to the clarity of the whole. Frequent and very pertinent references to scientific method are interspersed in the theoretical discussion, and serve to throw interesting sidelights on the

logical aspect of the subject (75, chap. II, 210, 228, 373–473, 477). The division of the book into parts and chapters with topical headings enables one to follow the course of the argument with great ease.

Although the title suggests historical growth rather than logical continuity of development, it is the latter with which Mr. D'Abro is concerned. The book is divided into four parts: Pre-relativity Physics, The Special Theory of Relativity, the General Theory of Relativity, and the Methodology of Science. In the first three parts "the essential features of Newton's great discoveries, the apparent inevitableness of absolute space and time in classical science, are passed in review. Then we come to Riemann, that great mathematician who wrested the problem of space from the dogmatic slumber where it had rested so long. Finally we see how Einstein succeeded in transporting to the realm of physics the ideas that Riemann had propounded, giving us thereby that supreme achievement of modern thought, the theory of relativity" (v). High points in the discussion are the author's treatment of non-Euclidean geometries and their relation to relativity (chaps. III, V), the various problems which arise in connection with the failure to differentiate between geometrical space and physical space (chap IV), the many meanings of the term "relativity" and the sense in which even the Newtonian science was relativistic (chaps. VIII, IX, X), the finiteness of the universe (chap. XXXIV).

The analysis of scientific method (Part IV, and especially chap. XXXVIII) was, from the point of view of my own personal interests, the most valuable aspect of the book. When a scientist, particularly a philosophically-minded scientist, writes upon method, something significant usually results. What the chapter lacks in structure (it is one hundred pages long and without subdivisions or subcaption of any kind) is compensated for by the pertinence of what is said. The author discusses such topics as the following: the methodological differences between science and philosophy (373–385), what is meant by saying that science is a world of constructs arrived at as a result of a synthesis of sense impressions (385–405), the place of mathematics and quantitative conceptions in a qualitative world (405–426), the nature of scientific explanation (426–434), the uniformity of nature and other principles of science (434–438), how scientific advance is always the result of the pressure of facts (438–473).

A book of this kind would be hardly complete were there not occasional flings at philosophers and the philosophical method. Mr. D'Abro lives up to tradition in this respect. But he makes a mistake in supposing that the particular type of philosophy which he is attacking is to be identified with philosophy in general. It is per-

missible to condemn the metaphysician "for deducing [does he mean *inducing?*] his knowledge from the crudest facts of daily experience" when the scientist bases his "deductions [again?] on extremely accurate observations embracing all the phenomena known to science" (384). But this is obviously only one type of metaphysics, and a type which is generally recognized to be more or less a thing of the past. There are bad philosophers, of course, and there are bad scientists, but one does not fairly measure either discipline by its poor samples. Nor does it follow that science has a monopoly upon accurate and certain knowledge, and that "whatever transcends the sphere of special sciences transcends it precisely because it is vague and only dimly apprehended" (384). Certainly this is the last place in which the author should be dogmatic, for one can not condemn philosophy by making philosophical statements. The author's entire chapter on method is, in fact, concerned with a subject-matter which "transcends the sphere of the special sciences," and is therefore philosophy, but it has all the marks, I should say, of being quite other than "vague and dimly apprehended." The philosophy of science is obviously not science, but is it therefore illegitimate?

The author is to be congratulated on having emphasized the empirical nature of the theory of relativity (206–211, 228). There has been a tendency in recent years to insist that relativity is purely a mathematical theory, and simply a system expressing a formal possibility. With this position Mr. D'Abro disagrees. "Thus, whereas in mathematics we may postulate anything we please (with certain reservations) and then proceed to reach our conclusions deductively, in physics this procedure is impossible. We must take our cue from experiment and formulate our premises accordingly" (210). This difference is clearly illustrated in the matter of definition. "Take a number like π in mathematics. We can define it as the ratio of the length of a circumference to its diameter in Euclidean geometry. Without performing physical measurements, we can deduce from this definition by purely mathematical means, the precise value of π to any order of approximation. . . . On the other hand, try to give a physical definition by some similar method—say, the definition of the 'gram' or of the 'dyne.' The purely logical type of definition breaks down, and we are compelled to resort to physical determinations" (210). "As for the theory of relativity, it is one of physics; it does not claim or aspire to be anything else" (211).

While agreeing with this distinction in its main outlines, I feel that Mr. D'Abro has introduced an artificially sharp line of demarcation between mathematics and physics. A purely logical definition is, after all, only an empirical definition whose elements have become inter-related into a conceptual system. The logical

definition is still empirical, but it is logical as well. Every concept is an abstraction from facts; in some concepts the abstraction is at a minimum and the concepts are therefore somewhat pictorial in nature; in others the abstraction is at a maximum and the concepts are hence less pictorial. But as abstraction increases other tendencies are at work. Chief among these is the organization and inter-relation of concepts into a deductive system. Thus a concept which involves a high degree of abstraction becomes inserted as an element in a conceptual system, and its truth is henceforth determined rather by its relations to other concepts in the system, than by the accuracy with which it describes facts. But it has not thereby ceased entirely to be descriptive; it is still pictorial of the events from which it was derived. Now the concepts of physics are obviously less abstractive than the concepts of mathematics, and the systematic inter-relation of concepts is therefore, in the former field, not so far advanced as in the latter. But to say that physics is empirical and not rational, and that mathematics is rational and not empirical, neglects entirely the fact that the rational is continuous with the empirical. Mr. D'Abro's example is easily explained from this point of view; one has only to re-word the definition of π so as to indicate its empirical nature, viz., if you measure the circumference and the diameter of any circle and divide the former by the latter, you will obtain a value which is approximately π. This definition obviously involves physical measurements. The fact that we are unable to give a logical definition of "gram" is not due to an inherent limitation in the nature of the concept; it is due simply to our own ignorance. Some day, when our knowledge of chemistry is more advanced, we may be able to pass by purely logical processes from the nature of distilled water to its necessary weight under certain conditions of temperature and pressure. Chemistry will then become rational, but it will not cease to be empirical.

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L'Ame Primitive.[1] LUCIEN LÉVY-BRUHL. (Bibliothèque de Philosophie Contemporaine.) Paris: Félix Alcan. 1927. Pp. 307.

This third and latest book by Professor Lévy-Bruhl is not, as had been generally supposed when the title was announced, a consideration of his favorite thesis applied specifically to the religious realm. The "soul" here considered is not a religious concept, but the spirit of man, its relation to the social conventions of the group, its boundaries of personality, its fate at death. The subject-matter

[1] *The "Soul" of the Primitive.* Authorized translation by Lilian A. Clare. New York: Macmillan Co. 1928. 351 pp.

includes consideration of the functions of the clan in marriage and blood revenge, the external soul, witchcraft against enemies, and, for half the bulk of the book, theories and practices centering about death.

There is in *L'Ame Primitive* a maximum of concrete material and a minimum of comment. In contrast to his two preceding books, Professor Lévy-Bruhl no longer insists on the contrast between the "completely rational" motivations of our own civilization and the pre-rational theories and representations of the primitive. Nor is he using as formerly his favorite term of "collective representations" for which "cultural traits" seems to be by this time a more definitive designation and in wider use. He has concentrated here on his third thesis of "mystic participation," that is, that the primitive mind does not delimit its subject-matter, but confuses it with a vast periphery which it is the function of this book to illustrate.

This thesis takes the form for Professor Lévy-Bruhl of an insistence on the identity, for the primitive, of object and symbol. When the wax image of one's enemy is melted with incantations before the fire, the primitive believes literally it *is* the body of his enemy; when the lock of the child's hair is buried under the floor to keep him from running away, the hair *is* the child, who is thereafter confined by definition. The bulk of the book is concerned with examples of this technique. For it is the testimony of a host of excellent observers that procedures of this sort *are* technique, and by no means imply that the native can make no distinction between the symbol and that which is symbolized. It is rather that just as we believe in a technique of the eradication of the cause, let us say, in disease, primitive man believes in a technique of analogy. "Like cures like" is his firm reliance. These analogies are the invariable techniques of magic, and are often categorized, but primitive medicine men are not therefore in doubt of the essential separateness of the two terms of their syllogism. Emotionally they may be able to drain off much excess emotion by behaving as if one were equivalent to the other, but the very foundations of magical procedure require a certain clear-headed distinction. It is not so much a case of mystical confusion as of a definite technical basis for procedure, immemorially accepted, and acted upon with matter-of-fact precision.

There is a further reason why this thesis of mystic participation seems insufficient. It is based obviously on the old associationalist psychology which regarded it as a matter of note that ideas should be illogically related to one another in the human brain. It is still this amazement that Professor Lévy-Bruhl is documenting in all his books, and he has not passed on, as modern psychology and the modern novel have, to ask further, what are the types of irrational

association? Can they be particularized? Do the various types they assume help us toward understanding the person or peoples of whom they are characteristic?

Professor Lévy-Bruhl in all his books has cleared the way for further research by his insistence on the irrationality of human procedure, and in his latest book it is noteworthy that he has further contributed by omitting our own civilization as the shining exception to this rule. But each generation has its own problems; for the present one, the form in which his problem is phrased seems too generalized, appears to stop short of the fruitful analysis, to be handicapped for lack of more rigorous psychological categories. It seems possible to study human irrationalities thrown large on the screen in the group behavior of isolated peoples, and the technique seems to call for the same careful differentiation of cultures, and the same large consideration of the total psychological complex as in the study of individual differences. If ever this end is attained in the study of primitive material, it may well be to such anthropologists as Tylor and Professor Lévy-Bruhl that such workers will feel themselves most closely related, scholars whose ineradicable emotion has been always amazement in the face of the irrationality of the material with which they were confronted.

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JOURNALS AND NEW BOOKS

BULLETIN DE LA SOCIÉTÉ FRANÇAISE DE PHILOSOPHIE. 27e Année, No. 5. L'Ordre Coopératif. Thèse: *Bernard Lavergne.* Discussion: *Ch. Andler, G. Belot, A Berthod, M. Croiset, E. Halévy, G. Lévy, Oualid, R. Picard, Rogrigues.*

ANNALEN DER PHILOSOPHIE. Band VII. Heft 7 u. 8. Gemütserregungen und Empfindungsgefühle: *J. K. v. Hoesslin.* Psychologische Deutung des Ursachenbegriffs und der Zahlenbegriffe: *Hermann Triepel.* Atomismus und Kontinuumslehre: *Rudolf Bojanovsky.* Die biologische Gewissheit des Individualistischen: *Martin Loesche.* Zielstrebigkeit?: *Paul Quittel.* Reichen die üblichen syllogistischen Regeln für das Schliessen in der positiven Logik elementarer Sätze aus?: *P. Hertz.*

RIVISTA DI FILOSOFIA. Anno XIX. N. 4. La morte dell'Eros: *G. Rensi.* La Fenomenologia di Husserl e l'Ontologia di Martin Heidegger: *G. Grasselli.* L'animale quale soggetto di diritto: *C. Goretti.*

LOGOS. Anno XI, Fascicolo 3. La filosofia di E. Meyerson e la logica dell'identità: *N. Abbagnano.* Lo spirito, la natura et l'edu-

cazione: *E. Catalano.* Nuove ricerche bibliografiche intorno a P. Galluppi: *E. Di Carlo.* La dottrina plotiniana delle idee individuali: *G. Capone-Braga.*

THE RICE INSTITUTE PAMPHLET. Vol. XV, No. 1. The Problem of Evil—Three public lectures delivered by Radoslav Andrea Tsanoff. I: The Problem of Evil in the Great Religions. II: Aristocracy Without Illusions: Alfred de Vigny. III: The Despair of Civilization.

SCIENTIA. Vol. XLIV. N. CC–12. L'evoluzione della teoria dei quanti: *E. Persico.* Kosmogonische Grundfragen: *F. Nölke.* The Rôle of Differentiation in Organic Evolution: *T. Brailsford-Robertson.* Le Statut de la Cour Permanente et les conventions d'arbitrage et de conciliation: *C. A. Reuterskiöld.*

Bailey, Cyril: The Greek Atomists and Epicurus. A Study. Oxford: At the Clarendon Press. 1928. ix + 619 pp. $8.00.

Burnet, John: Platonism. (Sather Classical Lectures). Berkeley: University of California Press. 1928. 130 pp.

Carritt, E. F.: The Theory of Morals. An Introduction to Ethical Philosophy. Oxford University Press. London: Humphrey Milford. 1928. xiii + 144 pp. $1.50.

Haering, Theodor L.: Hegel. Sein Wollen und sein Werk. Eine Chronologische Entwicklungsgeschichte der Gedanken und der Sprache Hegels. Band I. Leipzig und Berlin: B. G. Teubner. xxiv + 785 pp. 32 M.

Husserl, Edmund, editor: Jahrbuch für Philosophie und phänomenologische Forschung. In Collaberation with O. Becker, M. Geiger, M. Heidegger, A. Pfänder. Neunter Band. Halle a. d. S.: Max Niemeyer. 1928. x + 496 pp. 30 M.

Joël, Karl: Wandlungen der Weltanschauung. Eine Philosophiegeschichte als Geschichtsphilosophie. Lieferung 4, Band I. Bogen 31–46 und Titel zu Band I. Tübingen: J. C. B. Mohr (Paul Siebeck.) 1928. Pp. 481–735 + xv.

Lévy-Bruhl, Lucian: The "Soul" of the Primitive. Authorized Translation by Lilian A. Clare. New York: Macmillan Co. 1928. 351 pp. $5.00.

Rusk, Robert R.: The Philosophical Bases of Education. Boston: Houghton Mifflin Co. 1928. 205 pp. $1.75.

Sageret, Émile: Essais de Philosophie synthétique. Paris: Félix Alcan. 299 pp. 20 frcs.

Schneider, Herbert W. Making The Fascist State. New York: Oxford University Press. 1928. xi + 392 pp. $5.00.

Whittaker, Thomas: The Neo-Platonists. A Study in the History of Hellenism. With a Supplement on the Commentaries of Proclus. 2nd edition, reprinted. Cambridge: At the University Press. (American Agents, Macmillan Co.) xv + 318 pp.

NOTES AND NEWS

We regret to announce the death of Dr. Albert Lefevre, Corcoran Professor of Philosophy at the University of Virginia, on December 18, at University Hospital, Charlottesville, Virginia.

Professor Lefevre was born in Baltimore, October 4, 1873. He received the A.B. and A.M. degrees at the University of Texas, and then studied at the Johns Hopkins University, Cornell University, and the University of Berlin. He received from Cornell the Ph.D. degree in 1898, where he was lecturer in Philosophy. He was instructor at that university 1900–2, assistant professor, 1902–3. From 1903 to 1905 he was professor of philosophy at Tulane University; in 1905 he went to the University of Virginia as professor of philosophy. He translated (with Professor J. E. Crighton) *Immanuel Kant—His Life and Doctrine* by Fredrick Paulien.

Professor George H. Mead, of the University of Chicago, has been chosen by the Carus Lecture Committee of the American Philosophical Association to give the next series of lectures on the Carus Foundation.

We print below the program of the Twenty-eighth Annual Meeting of the Eastern Division of the American Philosophical Association, which meets December 27, 28, and 29, 1928, at the University of Pennsylvania.

THURSDAY, DECEMBER 27

5:00 p.m.

Meeting of the Executive Committee.

7:30 p.m.

Opening Session.

On a Definition of Consciousness.....*Edgar A. Singer, Jr.*
Social Meaning and the Concept of Society....*Clifford L. Barrett*
Toward a Metaphysic of Literary Criticism..*Philip E. Wheelwright*
The Creative Imagination.....*Morris Cohen*

FRIDAY, DECEMBER 28.

9:30 a.m.

Symposium: Philosophy of Religion

Topic: "In What Sense and to What Extent Does Religious Experience Afford Knowledge?".....*James Bissett Pratt*
James H. Leuba, Edgar S. Brightman, Alfred North Whitehead

1:00 p.m.

Luncheon tendered the Association by the University of Pennsylvania, Houston Hall. Welcome by *Provost Penniman.*

2:30 p.m.

Logic and the Theory of Knowledge

Alternative Systems of Logic.....*Paul Weiss*
Is Mathematics a Deductive Science?.....*Harold R. Smart*
The Next Step in the Epistemological Dialectic
Douglas C. Macintosh
A Re-examination of Critical Realism.....*Roy Wood Sellars*

7:00 p.m.

Annual Association Dinner

Rittenhouse Hotel.

Presidential Address, "The Ethical Problem".....*Felix Adler*

SATURDAY, DECEMBER 29.

9:30 a.m.

Annual Business Meeting.

10:30 a.m.

Discussion

Topic: "Are There Any Necessary Truths?"
Edward G. Spaulding, Wilmon H. Sheldon

ERRATUM: In the issue of this JOURNAL for November 22, 1928, it was incorrectly announced that the dates of the Ninth International Congress of Psychology, to be held at Yale University, would be September 1–17, 1929. The announcement should have read September 1–7, 1929.

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